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ABSTRACT

This longitudinal study examined the relationship of the physical-neurological conditions of infants at one minute after birth to mental and motor development at prekindergarten and kindergarten levels. Subjects were 44 children, 16 males and 28 females, born in 1970 in the same hospital. Neonatal physical status one minute after birth was assessed with the Apgar Test (an assessment of heart rate, respiration, muscle tone, reflect activity and color). The Apgar was correlated with pre-kindergarten assessment which is made up of measurements of large muscle activity, skill in drawing circles, squares, and triangles, a score for maturity, the number of body parts drawn and lastly the skill of coloring inside a lined diagram. Development at the kindergarten level was assessed through the Kindergarten Metropolitan Readiness test which includes auditory, visual, language and quantitative concepts. Pearson's Product Moment correlations within and between all three groups of measurements were calculated, as were Canonical correlations on various grouped subtest scores. Overall results indicated that the Apgar and prekindergarten assessment measures which showed a relationship were predominantly motor-neurological, whereas the Kindergarten Metropolitan Readiness components--being more cognitive--revealed little relationship to the other measures. In addition, when consistent within the motor domain, the Apgar was judged to be a valid measurement of neonatal health states, especially in the case of females. (CM)

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CORRELATIONS BETWEEN AND WITHIN THE APGAR TEST, PRE-KINDERGARTEN ASSESSMENT AND KINDERGARTEN PERFORMANCE

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June, 1978

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ABSTRACT

Correlations Between and Within the Apgar Test,
Pre-Kindergarten Assessment and
Kindergarten Performance

Professionals concerned with the health and well-being of infants and young children are constantly in search of early measurements which could be predictive of subsequent health and learning problems. Certainly the immediate health state of the infant is important to the obstetrics/pediatrics team responsible for observing early warning signs and providing medical attention for insuring survival and a good beginning. On the other hand, it is the educator who counsels and trains parents, who manages children and attempts to assist families in the socialization process.

Interestingly, the Apgar test--created by Virginia Apgar, an anesthesiologist--for assessing neonatal heart rate, respiration, muscle tone, reflex activity and color is recognized internationally as the standard measurement of infants one minute and five minutes after birth.

This research on 44 subjects was an attempt to discover if there is a relationship within or between the Apgar measurement, pre-kindergarten motor-perceptual performance and kindergarten Metropolitan Readiness scores.

The review of literature indicates an agreement about the general usefulness of the Apgar as an infant assessment, but there are divergent findings concerning the correlation of the Apgar with later performance. It is generalized by some that of the Apgar components, heart rate proves to be most reliable, followed by reflex irritability. Color consistently appears to be the poorest indicator. Scores below seven are indicative

of later serious low I.Q. performance. Some, however, have findings contradictory to this.

While this study did not include the Apgar five minute measurement nor the LBW (Low Birth Weight) factors, from the review of the literature both have emerged as most significant variables which should be undertaken in later studies.

Findings obtained by Pearson Product Moment and Canonical correlations reveal that within the components, Apgar reflex activity has the greatest significant relationship with heart rate and respiration and with the general maturity variable at the pre-kindergarten level. The maturity variable generally shows significance with other internal pre-kindergarten variables. Neither the Apgar nor the pre-kindergarten variables reveal a pattern of significant relationships to the kindergarten readiness components. Interrelatedness of female children's scores were consistently more significant.

In summary, the author suggests that the Apgar and pre-kindergarten assessment measures which showed a relationship were more predominately motor-neurological, whereas, the kindergarten Metropolitan Readiness components were more cognitive. When consistent within the motor domain of human behavior, the Apgar (particularly the reflex and to some degree the heart rate and respiration components) appears to be a valid measurement of neonatal health states. More so is this the case for females than for males.

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CORRELATIONS BETWEEN AND WITHIN THE APGAR TEST,
PRE-KINDERGARTEN ASSESSMENT AND KINDERGARTEN PERFORMANCE

CHAPTER I

INTRODUCTION

Nature of the Problem

To understand the development and potential of the very young child is to provide the parent or teacher with one of the basic tools for facilitating optimum mental and physical health. Many of the intervention strategies used in the education process are considered to be preventive and/or diagnostic. For example, if learning problems could be discovered earlier, recommendations for parent education or prescriptive teaching would be in order. As a consequence of parent education recommendations, more successful compromises could be made within child-parent-school interactions.

Measurement systems provide a great deal of information and while many tests for measurement of school age children exist, there are few for very young children. In fact, the younger the age, the fewer the tests. For neonates, the only consistently recognized examination is the Apgar test (Chamberlain, 1974, p. 1225; 1976, p. 403; Drage, 1969, p. 222).

The real significance of diagnosis for prevention comes not from the tests themselves, but from the longitudinal look at these tests in regard to growth and development. Early prediction of infant behavior is tenuous. Some believe there is a correlation of infant assessment for

later behavior; others do not consider that there is a relationship. For experimental reasons these effects must be examined through reported studies that correlate the demonstrated behavior or competencies of the infant with the skill and competence of the child at subsequent stages of development.

This research project will provide background information about the Apgar test, the pre-kindergarten measurement, and the Kindergarten Metropolitan Readiness and determine if there is a correlation of scores between and within the measurements. It is a retroactive study on 44 children.

Purpose of the Study

This study deals with the physical-neurological conditions of infants at one minute after birth and their relationship to mental and motor development at pre-kindergarten and kindergarten levels.

Neonatal physical status one minute after birth is considered in terms of basic body phenomena, such as heart rate, respiration, muscle tone, reflex irritability, and color. These criteria make up the Apgar test. The Apgar will be correlated with pre-kindergarten assessment which is made up of a measurement of large muscle activity, skill in drawing circles, squares, and triangles, a score for maturity, the number of body parts drawn and lastly the skill of coloring inside a lined diagram. Kindergarten Metropolitan Readiness (Buros, 1972, p. 757-759) scores which include auditory, visual, language, and quantitive concepts will also be included in the correlational studies.

In summary, the focus of this investigation concerns collected

observation and numerical data at each of the crucial periods of infant, pre-kindergarten and kindergarten levels and the correlation of scores received on tests given at each of these developmental levels.

Hopefully, the results will provide predictive data about subsequent behavior in very young children as well as more information relative to the components within each test.

Significance of the Study

The focus on early infant development has significance for various disciplines. Edwards (1968, p. 68-80) points out that the identification of childhood psychosis, neurosis, and psychosomatic illness are all phenomena traditionally attributed to by psychology. For special educators, brain damage and the vast array of psychomotor problems are necessarily important. For Home Economics it is the attempt to establish a normalized and positive environment for young children and particularly to assist parents via the education process to understand that they are the most important individuals responsible for establishing supportive home-social situations.

Regardless of the discipline, there has been a marked resurgence of interest in the study of the neonate. This interest is an outgrowth of the basic belief that early experiences are generally influential in the development and prevention of many disorders. As a result, the trend in present research with younger children is to focus on early behavior for symptomatic expressions which are suggestive of later behavior.

The significance of the study will be the correlational information as well as the attempt to establish fact of constancy in several sub-categories of function.

The constancy of function will be an important variable in two ways. First, correlations of the three sets of test scores will indicate if there is any functional relationship of the infant with later pre-kindergarten or kindergarten behavior.

Secondly, attempts will be made to learn if the specific items or criteria, individually judged, show different relationships. Some of the variables of functions appear to have more of a relationship than others (Chamberlain and Banks, 1974, p. 1125). For example, there is some suggestion that within the Apgar, color is less reliable and muscle tone may be more reliable (Faranisi, 1975, p. 1683).

This study should offer further confirmation of the position taken by other investigators that the newborn organisms' physical condition contributes to future development. It also provides information which contradicts to the notion that the neonatal behaves and responds in an all-in-one fashion. Rather, the new infant responds to early experiences and stimulation with variations in degree.

In general, the study offers additional information on the general relationship of infants which could, in turn, provide a basis for further research. Findings will be of importance to any human development discipline.

LIMITATIONS

This particular experiment made no attempt to control for related educational or social variables such as maternal education, birth weight, or economic status.

No information was collected relative to those neonates who expired and who might have had very low Apgar scores.

Five minute Apgar ratings are found to be important, but were not included in this particular study. The one hour Apgar ratings were also not included.

This research sample included 44 children. Some similar studies were done on samples no larger than this, but others included several hundred children. The author considers that the lack of a valid pre-kindergarten measurement to also be a limitation.

Parents who volunteered to participate were instructed about the task of collecting the hospital and school data, but in most cases did not "want to be bothered." Had it not been for the author's fortitude in volunteering to collect the scores, most of the parents would have dropped out of the study.

Hypothesis

1. There will be a significant correlation between the Apgar, pre-kindergarten and kindergarten scores.
2. There will be no differences in correlations of female children as compared with male children.

CHAPTER II

REVIEW OF THE LITERATURE

The Apgar Test

Dr. Virginia Apgar designed the Apgar method for assessing infants while deeply involved in her medical career in anesthesiology. She assisted in the delivery of more than 17,000 babies and witnessed the clinical evaluation of neonates. Procedures observed were haphazard and disorganized. Her method brought a systematic approach to assessment and became a meaningful procedure and internationally recognized code for the evaluation of the newborn (Apgar, 1965; Medovy, 1974, p. 1025). It is generally recognized as a simple, but yet precise method of evaluating a newborn's neurological and physical status (Niswander, 1976, p. 403). The infant's condition is evaluated at 60 seconds, and in some hospitals also at five minutes and one hour after birth. The five objective signs are heart rate, respiration effort, muscle tone, reflexes and skin color. A score of 0, 1, or 2 is assigned to each of the sub-categories. A score of 7 to 10 is considered satisfactory, 4 to 7 indicates a need for careful observation and possible concern, while a score below 4 serves as an alert for possible emergency procedures and raises some doubts about survival (Medovy, 1974, p. 1025).

Table 1 (page 29) shows the actual Apgar Rating System (Drage, 1969, p. 222; Niswander, 1976, p. 403; Chamberlain, 1974, p. 1225).

Dr. Apgar's contribution has had international impact and according to Medovy (1974, p. 1025) the term "Apgar" has been used by nurses and doctors and is now like a household term. Most, however, do not know that it is a memorial for an outstanding scientist. In 1959, Dr. Apgar left anesthesiology to join the National Foundation March of Dimes at a critical period in the history of the organization. It was the time when resources of that organization were being diverted from poliomyelitis to the problem of birth defects. Professionals in infancy now realize the impact of the March of Dimes organization in the fight against birth defects.

Usefulness

Relative to the usefulness of the Apgar, Chamberlain (1974, p. 1226) suggests that except for heart-rate, an Apgar Score of 2 in any component is of little value as a precise predictor.

Generally, Goodwin and Godden (1976, p. 203) suggest the Apgar scores 7 to 10 will indicate vigorous behavior and scores 0 to 6 will be indicative of a depressed state.

Niswander (1976, p. 403) believes that a score of less than 4 means some depression and need for more support.

Increasingly, the Apgar is becoming a measurement used in conjunction with numerous other variables. For example, Caldwell and other (1974, p. 911-916) recorded temporal and acoustic features of the cries of 25 male and female neonates with high (8 and up) Apgar scores.

In one study of 212 LBW (Low Birth Weight) infants, Drorbagh (1975, p. 532) found that 49 were abnormal or suspect at age 7 and suggested that the Apgar test was one of the useful criteria in this determination. Further, in the same study 45 of the 67 LBW infants who died in the neonatal period had Apgar scores of six or less at five minutes of age. We would have to assume that the one minute measurement was at least no greater than the five minute and probably less.

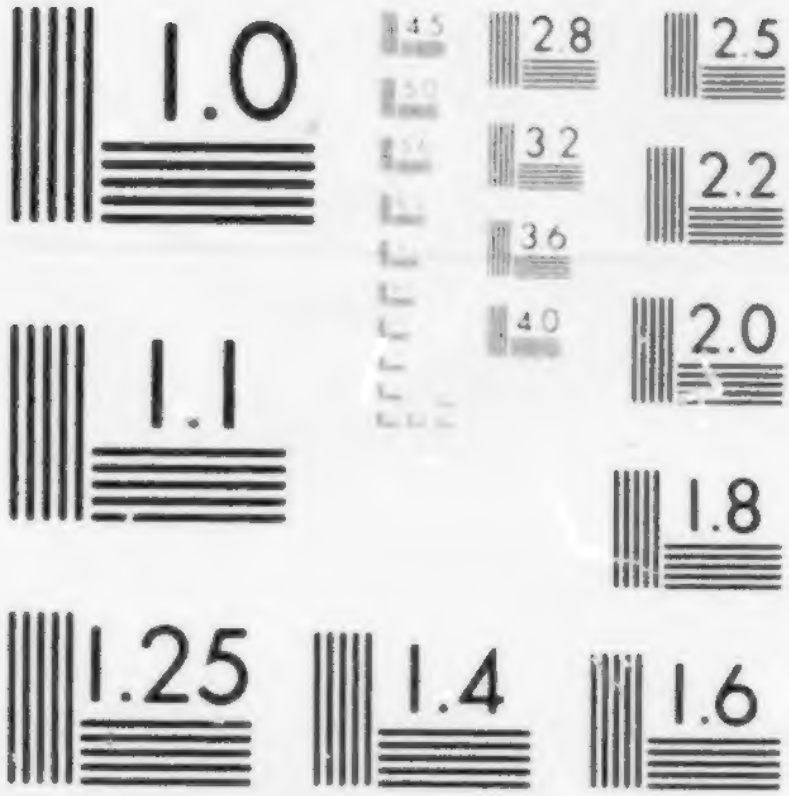
Davie and others (1972, p. 191) state:

> Many obstetric complications, while carrying a high risk of perinatal mortality, do not seem in general to be linked to adverse development in surviving children. On the other hand, a number of high risk factors have been isolated and this permits the early identification of a relatively small group of children in whom the risk of handicap is increased.

Some believe the Apgar can be useful in isolating these high risk factors.

Drage (1969, p. 222,227) indicated that Virginia Apgar's observations included the association of low one-minute scores to increased neonatal mortality and in addition, that in any given instance the lower mean I.Q. is generally associated with the lower Apgar score.

Constancy of functions can possibly be extended backward as well as forward, according to a study done by Schifrin (1972, p. 1322-1325). FHR (Fetal Heart Rate) during the last 30 minutes of labor were accurate predictions of high Apgar scores. Adnormal FHR patterns were conservative predictors of low Apgar scores.



MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS 1963-A

Tenbrinck (1974, p. 555-560) tested one hundred young children for possible mental retardation. Those with a history of birth injury were studied in retrospect for a possible relationship of the Apgar score at birth to their intelligence predicting later neurological deficit. It was not found to be significantly useful in the genetic and non-birth allied conditions. Further, observations in a collaborative study showed that the Apgar score taken at five minutes instead of one minute is a more accurate index of the likelihood of neurological effects. Neurological abnormalities were studied at one year of age and noted to be more significant when associated with low birth weight as well as an Apgar score of six or lower.

Tenbrinck (1974, p. 559) further indicated in his study that the height of the I.Q.'s obtained decreases with a fall in the Apgar score. The lowest I.Q.'s and averages did not seem to follow this trend.

According to Purokit (1976, p. 405) a low five minute score reportedly correlated with neurological deficits in the one year old infant. However, this correlation is not sustained at age four.

In another more extensive study of 913 high risk pregnancy cases, Walters (1973, p. 307-314) reported at least two cases of infants who had received scores of 8 at one minute, but a score of 10 at five minutes and were still diagnosed as moderately retarded according to the Denver Developmental and Stanford-Binet given at age three.

Bjeria (1975, p. 859-864) investigated the neurological condition of five year olds with LBW (Low Birth Weight). This study with handicapped children indicated a definite relationship between LBW, low developmental quotient and a high incidence of minor injuries. The

perinatal data, however, was not useful in recognizing any particular handicap.

One of the most statistically significant findings was in a study done by Serunian (1975, p. 696-700). In this study, Apgar scores were correlated with Bayley Mental and Motor scores. These significantly predicted abnormalities in each of the areas on neurological status, motor development, muscle tone, and grasp. Further, there was a significant relationship between low Apgar and high mortality rates.

A study with twins comparing Negro with Caucasian children revealed that Negros had lower Apgar scores along with lower socio-economic ratings, shorter gestation and lower birth weight (Howard, 1970, p. 519-530).

Turkenwitz (1968, p. 243-249) found in a study which examined the neuro-behavioral organization of children whose condition differed at birth, that normal Apgar scores (9-10) were more responsive to stimulation of the right side of the body than of the left. For those whose scores (1-6) were poor at birth, the degree of reaction was smaller and no differentiation between left and right was made.

According to Henderson (1971, p. 139-140) variables of birth weight, type of delivery, and Apgar were found to have a significant correlation with the WISC I.Q. In this case, race and mother's occupation also proved to have a significant relationship with the WISC I.Q. score.

Shipe, (1968, p. 861-866) in her examination of 33 preschool children found no relationship to later performance in psychometric tests or personality ratings. In this particular study the Pacific Multifactor test battery, the Stanford-Binet L-M, and a Parent Questionnaire were used.

Lewis and others (1967, p. 461-465) used the Apgar scale as a measure of birth condition in relation to the observed attentive behavior of approximately 40 infants at 3 and 9-13 months. Findings indicate that infants rated between 7-9 on the Apgar scale at birth were significantly less attentive than infants rated 10. This difference, in general, held over the first year of life and indicated that individual differences in infant attention within the first year of life are a function in part, of birth condition.

Possibly most similar to this research and concurrently comprehensive was the experiment done by Edwards (1968, p. 283). Through this study it was learned that:

> scores evaluating aspects of physical condition at one and five minutes after birth were significantly related to scores on psychological tests evaluating intelligence, conceptual abilities, and fine motor coordination at four years of age. The magnitude of the correlation coefficient between physical conditions at one and five minutes and later development was higher in connection with fine and gross motor coordination than with intelligence and conceptual abilities.

Component Predictors

The Apgar score has made a major contribution to neonatal assessment, but are all parts of it equally useful?

Chamberlain and Banks (1974, p. 1226) suggest "that heart rate is a good predictor, reflex irritability is the next best, followed by muscle tone and respiration, with color as a poor last."

Drage (1969, p. 227) states:

> the relationship between Apgar scores and fine and gross motor assessments, fine motor deficiencies seem most strongly relative to low scores, followed to a lesser degree by gross motor findings.

In the selective analysis of the individual functions in the Apgar scores as recorded, 30 of the group revealed abnormal (bluish) color and this was considered to be the most significant factor (Tenbrinck, p. 558).

Edwards (1968, p. 283) found that among the individual Apgar ratings, muscle tone accounted for more of the variance in four-year ratings than heart rate, respiratory effort, reflex irritability and color.

According to one author, there seems to be agreement that color is generally accepted as being the least reliable....but there is no agreement on the relative importance of the other four components (Faranish, 1975, p. 168). Continuing in this respective study of 100 babies, it was concluded that when Apgar scores are 3 to 7, greater predictive accuracy can be achieved for the individual baby by paying particular attention to the initial degree of muscle tone and it's responses to therapy.

The fact that the system has no exact measurable value and thus, prone to subjective influences is, according by Boenisch (1974, p. 122), the main drawback of usefulness for the Apgar.

CHAPTER III

PROCEDURES

The Sample

Describing the sample is one of the most interesting parts of this research effort. Having developed and taught a course in Infant Development, the author has long been interested in the neonate. Concurrently, no one can teach infant development without being inquisitive about the Apgar. It was through this relationship that the author conceived the research idea and therefore, began to search for an appropriate population.

Historically, infant research data (like the Apgar scores) is medically related and basically has been unavailable to educators. With the new "rights to information" laws some change in this tradition has been observed. As a consequence of parents having access to information previously considered to be confidential, the author decided to approach a Northwest Ohio area hospital to explore the possibility of obtaining a sample for the Apgar research.

The perceived plan was to select parents who had delivered babies in 1970 so that the retroactive Apgar, pre-kindergarten, and kindergarten data would be immediately available.

From conferences with the hospital director of pediatrics, director of obstetrics and director of research, there was agreement

that the project was feasible. While this process took some months, the director of research and the author agreed that the best way to obtain the sample would be to identify from newspaper records names of parents who delivered babies at this particular hospital.

Because newspapers are public records, there would be no breech of confidentiality in making the initial contact. It was further agreed that choosing these approximate 250 names each for one week in January and one week in July would give a cross section of season and out of the total 500 retroactively chosen names there would likely be an approximate 50 returns. Approximately 50 were needed for research purposes.

In order to provide every ethical caution and consideration, the author purged the death records from 1970 to the fall of 1976, attempting to guard against contacting parents relative to participation where they baby might have died.

After this was completed, the author corresponded with the parents explaining the nature of the study and inviting them to participate.

Hospital personnel were kept fully aware and after the approximate 70 parents returned signed statements of willingness to participate, the author returned to the hospital to begin the data collection process. Concurrent data collection permission was received from the Toledo Public Schools and subsequently, the exact school in which the child was enrolled was identified. Note Appendix A (page 45) for a variety of communications used.

Approximately eight months was required to this point in the process. Even though the resident physicians had been kept informed, some members decided at this time to disallow continuance of the research. The

rationale was based on possible insurance claims which could arise from the research findings.

Even though parents in the original group had forwarded signed permission statements the author considered it to be professionally unethical to contact these parents suggesting that respective information that should have been available was in reality, not available. This initial population was, therefore, abandoned and procedures were initiated to recruit a second sample. Steps taken were:

1) To contact the local school superintendent to ascertain his interest in the research project and in giving permission to collect a retroactive sample via the school system.
2) The superintendent agreed that the research was of an important nature--to the degree, in fact, that he suggested attaching a cover letter to the author's written request for parents to participate.
3) A letter of explanation and permission forms were distributed to parents of first grade children in all city schools. (Note Appendix B, page 46.)
4) Approximately 60 returned signed interest forms were routed via the superintendent's office to the researcher.
5) The author corresponded with each specific family relative to instruction about collecting appropriate data. (Note Appendix C, page 47.)
6) Follow-up phone calls were made and assistance offered where needed. (In most cases, the author collected the respective hospital and school data.)
7) A final count of 44 children made up the sample for the study. Sixteen were male and twenty-eight were female.

The Ratings Systems

Some variables were "grouped" in like categories in order to determine additional Pearson and Cancnical correlations. For example, the pre-school criteria of circle, square & triangle were used separately and as a group. In the information below each instance of grouped variables is noted.

Apgar

Note pages 6 & 7 and Table 1 (p. 29) for a review of the literature section for the Apgar criteria and rating system format.

While the Apgar test can be given at one minute, five minutes, and one hour after birth, only the onc minute score was used for this study. The sample selected was a retroactive one and in the early 1970's the Apgar was not as popular as it now is. The last decade has shown rapid growth in the use of this assessment system. In fact, it is now common to have a mother come out of the delivery room and ask, "What is my baby's Apgar?"

Apgar components consist of heart rate, muscle tone, reflex activity, respiration, and color. Each are given a score of 0, 1, 2..... maximum total score of 10 could be given, or the score could range downward to 0. The healthier the infant, the higher the score.

Preschool

The preschool instrument used was one part of a non-standardized test made up of a number of physical motor activities.

Criteria used were:

- Draw a person's parts
- Ability to draw a circle
- Ability to draw a square
- Ability to draw a triangle
- A maturity ranking from 1-10

} Singly & Grouped

- Ability to write inside a prescribed lined area
- Large muscle activities (One composite course, catching.)

The preschool information was not available for all 44 children. The city school system was only beginning the preschool testing.

Metropolitan Readiness Test

The Metropolitan is a standardized test which seems to have predictive validity when used as a total test rather than as separate sub-tests. Numerous tests of validity have been conducted and norms have been established on 15,081 white children. Those who have reviewed the Metropolitan strongly emphasize that other factors should be included when considering the child's readiness for first grade. Secondly, sub-test components should not be used for evaluation of individuals. Given these precautions, it is suggested that the Metropolitan Readiness Tests are among the superior tests now available (Buros, 1972, p. 1716-1717). A copy of the test is shown in Appendix F (page 50).

Components in the Metropolitan Readiness Test are:

Auditory

1. Beginning consonants
2. Sound-letter correspondence

} Singly & Grouped

Visual

3. Visual matching
4. Finding patterns

} Singly & Grouped

Language

5. School language
6. Listening

} Singly & Grouped

Quantitative

7. Quantitative concepts
8. Quantitative operations

} Singly & Grouped

Analysis

Methodology

Pearson's Product Moment correlations within and between all three groups of measurements were calculated. Canonical correlations were calculated on various "grouped" sub-test scores. Correlations significant at the .05 level were determined as were those at the .01 level.

Variables correlated and quantitative scoring systems used in the study are as follows:

Apgar

Symbol	Variable	Scoring System
X1	Heart Rate	0, 1, 2
X2	Respiration	0, 1, 2
X3	Muscle Tone	0, 1, 2
X4	Reflex	0, 1, 2
X5	Color	0, 1, 2

Metropolitan Readiness*

Symbol	Variable	Scoring System
Y1	Beginning consonants (Auditory)	Two digit number
Y2	Second letter consonants	Two digit number
Y3	Visual Matching (Visual)	Two digit number
Y4	Finding Patterns	Two digit number
Y5	School Language (Language)	Two digit number
Y6	Listening	Two digit number
Y7	Quantitative Concepts (Quantitative)	Two digit number
Y8	Quantitative Operations	Two digit number

*(Note Appendix D (page 48) for more details.)

Pre-Kindergarten*

Z1	Draw-a-man parts	14 parts
Z2	Circle	
Z3	Square	
Z4	Triangle	
Z5	Maturity	Low 1 - 10 High Score
Z6	Writing	1- scribbles 2 - average 3 - advanced (inside lines)
Z7	Large Muscle	
Z8	Sex	

*(Note Appendix E (page 49) for more details.)

CHAPTER IV

FINDINGS

Important results obtained by the Pearson Product Moment and Canonical correlations can be summarized as follows: Of the Apgar components, reflex irritability was significantly related to heart rate and respiration. Thus, reflex irritability appears to be the most reliable measure of the neonatal neurological state. Note Table 3 for detailed Apgar component Pearson correlations.

Within the pre-kindergarten assessment, maturity, the ability to "draw-a-man" parts and large muscle components proved to have significant relationships. Thus, from this study it appears that the pre-kindergarten child who is generally more mature will also exhibit more large muscle skills and will have more knowledge about body parts. Note Table 4 for detailed pre-kindergarten Pearson correlations.

Within Metropolitan Readiness scores there was a scattered and large variety of significant relationships established. These ranged throughout the Metropolitan sub-test areas and did not show any consistent direction. This supports the suggestion that the Metropolitan Readiness sub-tests can be used as independent measures, but that using the test as a "whole" will be more useful. For further details see Table 5 (page 33).

When Pearson correlations were obtained between the pre-kindergarten and the Apgar variables, some interesting results which support earlier component findings were noted. For example, large muscle, maturity and "draw-a-man" scores correlated with respiration. For additional information in this category refer to Table 6 (page 34).

Between Apgar and Kindergarten Metropolitan Readiness scores, respiration significantly related to listening heart rate with quantitative concepts was the other significant relationship. These, support earlier Apgar sub-component trends. Note Table 7 (page 35) for further Pearson Apgar with Kindergarten correlational data.

Pearson correlations between pre-kindergarten and kindergarten Metropolitan Readiness scores revealed no consistent pattern of findings. Maturity and "draw-a-man" variables showed a relationship with the greatest number of kindergarten components, but there was no strong pattern established. Note Table 8 (page 36) for additional information.

When Pearson correlations are obtained from Kindergarten Metropolitan combined sub-scores and pre-kindergarten circle, square and triangle, it was the pre-kindergarten circle/square/triangle combined variables that significantly related to every other pre-kindergarten variables, but with none of the Kindergarten Metropolitan combined sub-scores. Note Table 9 (page 37) for exact correlational data.

Grouped and individual Kindergarten Metropolitan scores correlations show comprehensive patterns of significant relationships. This supports the notion of reliability and validity within the Metropolitan Readiness test. No significant relationships exist between Kindergarten Metropolitan grouped sub-scores and Kindergarten circle/square/triangle scores. Note Table 10 (page 38) for specific correlational data.

No patterns of significant relationships exist between Apgar components and grouped Kindergarten Metropolitan scores nor pre-kindergarten grouped circle/square/triangle. Note Table 11 (page 39) for exact data.

When grouped Kindergarten Metropolitan Readiness scores are correlated, each of the grouped sub-components showed some pattern of significant relationships. None of these grouped kindergarten components correlates with pre-kindergarten circle/square/triangle scores. Note Table 12 (page 40) for these specific scores.

Canonical correlation between Apgar and Kindergarten Metropolitan Readiness scores revealed no significant differences. Note Table 13 (page 41) for specific Apgar and Kindergarten canonical data. Note Table 14 (page 42) for Apgar Pre-kindergarten canonical data.

Between Kindergarten Metropolitan and Pre-kindergarten variables, canonical coefficient correlations revealed no significant differences. Table 15 (page 43) reports this data.

Male/Female sex variables shown in Table 16 indicate that the female scores had significant coefficient correlations in the Kindergarten areas of second letter, listening, and quantitative operation. While there is no clear or comprehensive direction of significant relationship there is enough to say that female scores were higher than those for male children.

CHAPTER V

SUMMARY & RECOMMENDATIONS

Summary

There are significant relationships with the Apgar reflex variable component and both heart rate and respiration but none in any other combinations.

There appears to be a pattern within the kindergarten variables of influence of finding patterns and visual matching with second letter correspondence.

The pre-kindergarten maturity variables show a pattern of influence with kindergarten auditory skills and between writing at the pre-kindergarten level and finding patterns at the kindergarten level.

A clear pattern of relationships exist within the Kindergarten Metropolitan Readiness variables, but no clear pattern was revealed between the pre-kindergarten and kindergarten variables.

The maturity variable at the pre-kindergarten level showed a pattern with skills of writing and large muscle variables and there was a relationship between the writing and large muscle scores.

Separately, the pre-kindergarten circle, squares and triangle showed no consistency, but when combined they revealed a significant correlation with other pre-kindergarten variables.

When the Kindergarten Metropolitan Readiness components are combined, a consistent pattern of very high correlations in the auditory, visual, and quantitative sections are revealed.

Inferences from the findings suggest that the Apgar and pre-kindergarten measurements are more comprehensibly neurological-motor and, therefore, show more significant relationships--while the Kindergarten Metropolitan Readiness components are basically cognitive and, therefore, revealed little relationship.

Inconsistent patterns within the pre-kindergarten components suggest a lack of reliability and validity in this particular pre-kindergarten instrument.

Recommendations

It is recommended that contacts with medical personnel in relation to cooperative research efforts continue. Increasingly, there is interrelated concern for "parents and children". This cooperative approach provides opportunity for "theory into practice" experiences beneficial to both the parent and the profession. Further, as similar efforts increase, the process will become easier.

A second recommendation is concerned with the choice of instruments. Similar efforts need to be promoted using a validated and more comprehensive pre-kindergarten assessment, as well as a kindergarten assessment that is less cognitive and more motor oriented.

Lastly, the Low Birth Weight (LBW), the five minute and one hour Apgar assessment need continued investigation. In fact, correlational studies within or between any of the assessment strategies would be useful. This author plans to continue with the low birth weight variable as it correlates with the Apgar at one minute, 5 minutes and one hour.

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TABLE 1

The Apgar Rating System

Sign	Score 0	Score 1	Score 2
Heart Rate	Absent	Slow (100/min.)	100/min.
Respiratory-rate	Absent	Slow irregular	Good crying
Muscle tone	Flaccid	Some flexion of extremities	Active motion
Reflexirritability	No response to slap on feet	Grimace	Cry
Colour	Blue, pale	Body pink, extremities blue	Completely pink

TABLE 2

Means, Standard Deviations of Apgar, Kindergarten & Pre-Kindergarten Scores

Variable	Mean	Std Dev
X1	1.9545	.2107
X2	1.8636	.3471
X3	1.9545	.2107
X4	1.9091	.2908
X5	1.2727	.4995
Y1	11.0455	2.6672
Y2	12.1818	3.5652
Y3	7.8409	1.8165
Y4	12.2955	3.6254
Y5	9.3864	8.9526
Y6	6.8864	2.3842
Y7	6.5682	2.8152
Y8	10.2045	3.2320
Z1	7.4091	3.6493
Z2	.5682	.5011
Z3	.5909	.4974
Z4	.2045	.4615
Z5	7.0227	3.2742
Z6	2.0000	1.0343
Z7	15.8182	7.1991
Z8	1.3636	.4866
Y12	23.2273	5.3172
Y34	20.1364	4.8301
Y56	16.2727	9.4164
Y78	16.7727	5.3347
Z234	1.3636	.8378

TABLE 3

Pearson Correlations Within Apgar

		X1	X2	X3	X4	X5
Heart Rate	X1	1.0000	-.0867	-.0476	-.6901**	.1205
Respiration	X2	.0867	1.0000	-.0867	.3351*	.2195
Muscle Tone	X3	-.0476	-.0867	1.0000	-.0690	.1205
Reflex	X4	.6901**	.3351*	-.6890	1.0000	.1747
Color	X5	.1205	.2195	.1205	.1747	1.0000

*Significance at the .05 level
**Significance at the .01 level

TABLE 4

Pearson Correlations within Pre-Kindergarten Scores

Variables		Z1	Z2	Z3	Z4	Z5	Z6	Z7
Draw-A-Man	Z1	1.0000	.3024*	.6453**	.0458	.6941**	.7270**	.6925**
Circle	Z2	.3024	1.0000	-.1654	-.0114	.4314**	.2244	.5193**
Square	Z3	.6453*	-.1654	1.0000	.1704	.4771**	.4973**	.2710
Triangle	Z4	.0458	-.0114	.1704	1.0000	-.1263	.0000	.1794
Maturity	Z5	.6941**	.4314**	.4771**	-.1263	1.0000	.8241**	.7855*
Writing	Z6	.7270**	.2244	.4973**	.0000	.8241**	1.0000	.7215**
Large Muscle	Z7	.6925*	.5193**	.2710*	.1794	.7855*	.7215**	1.0000
Sex	Z8	.0744	-.0087	.0524	.1789	.0531	.0924	-.0006

*Significance at the .05 level

**Significance at the .01 level

TABLE 5

Pearson Correlations Within Kindergarten Metropolitan Readiness Scores

Variable		Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8
Beginning Consonants	Y1	1.0000	.4442**	.5103**	.6864**	-.0339	.4360**	.4827**	.4251**
Second Letter	Y2	.4442	1.0000	.4534**	.6867**	.2484*	.6208*	.5734*	.6284*
Visual Matching	Y3	.5103	.4534	1.0000	.5229**	.0382	.4951*	.6275*	.4058*
Finding Patterns	Y4	.6864	.6867	.5229	1.0000	.1282	.4237*	.4298*	.5306*
School Language	Y5	-.0339	.2484	.0382	.1282	1.0000	.0664	.0686	-.0791
Listening	Y6	.4360**	.6208**	.4951**	.4237**	.0664	1.0000	.8414*	.5433*
Quantative Concepts	Y7	.4827**	.5734**	.6275**	.4298**	.0686	.8414	1.0000	.5544*
Quantative Operations	Y8	.4251**	.6284**	.4058*	.5306**	-.0791	.5433*	.5544*	1.0000

*Significance at the .05 level

**Significance at the .01 level

TABLE 6

Pearson Correlations Between Pre-Kindergarten and Apgar Scores

Variables Pre Kindergarten		Heart Rate	Respiration	Muscle Tone	Reflex	Color
		X1	X2	X3	X4	X5
Draw-a-man	Z1	-.0357	.3755**	-.2777*	.0797	.0905
Circle	Z2	-.1902	.1884	-.1902	.0435	.2957*
Square	Z3	.2623*	.0735	-.1816	.2193	-.1957
Triangle	Z4	.0978	-.1122	.0978	.1418	-.1467
Maturity	Z5	-.1333	.3506**	-.0659	.0755	-.0465
Writing	Z6	-.2134	.1943	.2134	-.0773	.0900
Large Muscle	Z7	-.0976	.4086**	-.0045	.0919	.0853
Sex	Z8	.0958	.0945	-.1677	.2343	-.0202

*Significance at the .05 level

**Significance at the .01 level

TABLE 7

Pearson Correlations Between Apgar and Kindergarten Metropolitan Scores

Variables Apgar		Beginning Consonants	2nd Letter	Vis. Mat.	Finding Patterns	2nd Lang.	Listening	Quantative Concepts	Quantative Operations
		Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8
Heart Rate	X1	-.0790	-.0507	-.1409	.0180	.0588	-.1031	-.2691*	.0140
Respiration	X2	-.1439	.0581	.0386	-.1705	.0473	.0370	.1287	.0462
Muscle Tone	X3	.0038	.1970	-.0193	.0180	.0095	-.1031	-.1123	.0823
Reflex	X4	-.1145	.0612	.0600	-.0180	.0674	.1189	.0646	.2182
Color	X5	-.0619	-.0546	-.0023	-.0198	.1995	.2024	.0030	.0655

*Significance at the .05 level

**Significance at the .01 level

TABLE 8

Pearson Correlations Between Pre-Kindergarten and Kindergarten Metropolitan Scores

Kindergarten		Draw-A-Man	Circle	Square	Triangle	Maturity	Writing	Large Muscle	Sex
		Z1	Z2	Z3	Z4	Z5	Z6	Z7	Z8
Beginning Consonants	Y1	.2943*	.0150	.2072	-.0077	.2875*	.2192	.2088	-.0489
Second Letter	Y2	.2319	-.2414	.2659*	-.2210	.2566*	.3280*	.0611	.2559*
Visual Matching	Y3	.0100	-.0517	.0293	-.2309*	.2118	.0866	-.0414	.1196
Finding Patterns	Y4	.2701*	-.1458	.2363*	-.2732*	.2247	.2605*	.1384	.1222
School Language	Y5	.0762	.1988	.1251	-.0927	.2306	.2059	.1815	-.0757
Listening	Y6	.2674*	-.0810	.2933*	.1273	.0808	.1886	-.0053	.2770*
Quantative Concepts	Y7	.1602	.0131	.1367	.0875	.2483*	.2077	.1223	.2361
Quantative Operations	Y8	.2570*	-.2170	.0099	.0025	.0787	.2157	.0856	.3804**

*Significance at the .05 level

**Significance at the .01 level

TABLE 9

Pearson Correlations between Kindergarten Metropolitan Combined Sub-Scores and Pre-Kindergarten Separate and Grouped Circle/Square/Triangle Variables

Variables	Grouped	Draw-A-Man Z1	Circle Z2	Square Z3	Triangle Z4	Maturity Z5	Large Muscle Z6	Sex Z7
Auditory	Y12	.3031	.1543	.2822	-.1521	.3163	.3298	.1457
Visual	Y34	.2065	-.1289	.1883	-.3258	.2483	.2281	.0883
Language	Y56	.1402	.1685	.1932	-.0559	.2397	.2436	.1712
Quantative	Y78	.2402	.1246	.0781	.0477	.1787	.2402	.1164
Circle/Square/ Triangle	Y234	.5892**	.4936**	.5886**	.6452**	.4717**	.4294**	.5703**

*Significance at the .05 level

**Significance at the .01 level

TABLE 10

Pearson Correlations Between Kindergarten Metropolitan Grouped and Individual Scores with Pre-Kindergarten Grouped Circle/Square/Triangle Scores

		Auditory Y12	Visual Y34	Language Y56	Quantative Y78	Circle Sq/Triangle Z234
Beginning Consonants	Y1	.7995**	.7071**	.0782	.5123**	.1277
Second Letter	Y2	.8933**	.6859**	.3933**	.6833**	-.0183
Visual Matching	Y3	.5600**	.7685**	.1617	.5770**	-.1903
Finding Patterns	Y4	.8047**	.9472**	.2292*	.5483**	-.0974
School Language	Y5	.1496	.1106	.9676**	-.0118	.1421
Listening	Y6	.6350**	.5042**	.3163*	.7732**	.1958
Quantative Concepts	Y7	.6266**	.5586**	.2783*	.8636**	.1371
Quantative Operations	Y8	.6346**	.5509**	.0623	.8984**	-.1226

*Significance at the .05 level

**Significance at the .01 level

TABLE 11

Pearson Correlations Between Apgar, Grouped Kindergarten Metropolitan and Pre-Kindergarten Grouped Circle/Square/Triangle Scores

Apgar		Auditory Y12	Visual Y34	Language Y56	Quantative Y78	Circle Square/Triangle Z234
Heart	X1	-.0736	-.0395	.0298	-.1335	.0958
Respiration	X2	-.0332	-.1135	.0543	.0959	.0945
Muscle Tone	X3	.1340	.0062	-.0170	-.0094	-.1677
Reflex	X4	-.0164	.0090	.0942	.1663	.2343
Color	X5	-.0677	-.0833	.2409*	.0413	.0202

*Significance at the .05 level

**Significance at the .01 level

TABLE 12

Pearson Correlations Between Grouped Kindergarten Metropolitan and Circle/Square/Triangle Pre-Kindergarten Scores

		Y12	Y34	Y56	Y78	Z234
Beginning Consonants	Y12	1.0000	.8146**	.3030*	.7151**	-.0085
Visual	Y34	.8146**	1.0000	.2328	.6285**	-.1447
Language	Y56	.3030*	.2328	1.0000	.1846	.1846
Quantative	Y78	.7151**	.6285**	.1846	1.0000	-.0019
Circle/ Square/ Triangle	Z234	-.0085	-.1447	.1846	-.0019	1.0000

*Significance at the .05 level

**Significance at the .01 level

TABLE 13

Canonical Correlations Between Apgar and Grouped Kindergarten Metropolitan Variables

Canonical Correlation = .56213

(Significant at the .386 level)

Note: Since the canonical correlation is not significant, the canonical coeffecients are not included.

TABLE 14

Canonical Correlations between Apgar and Pre-Kindergarten Variables

Canonical correlation = .83595
(Significant at the .000 level)

Pre-Kindergarten Variables	Canonical Coefficient
Z 1 (Draw-a-Man)	-1.18615
Z 2, 3, 4 Circle/Square/Triangles	.16992
Z 5 Maturity	- .81513
Z 6 Writing	1.58489
Z 7 Large Muscle	.01642
Z 8 Sex	.19274

Apgar Variables	Canonical Coefficient
X 1 Heart Rate	- .37022
X 2 Respiration	- .57693
X 3 Muscle Time	.80396
X 4 Reflex	.25690
X 5 Color	.10672

TABLE 15

Canonical Correlations between Kindergarten Metropolitan and Pre-Kindergarten Variables

Canonical Correlation = .50069

(Significant at the .498 level)

Note: Since the correlation is not significant, the canonical coefficients are not included.

TABLE 16

Sex (Z8) Variable Correlations

Apgar		
X1		.1650
X2		-.1126
X3		.1650
X4		.2390
X5		-.0348
Grouped Kindergarten		
Y12	Auditory	.1471
Y34	Visual	.1367
Y56	Language	-.0018
Y78	Quality	.3551
Kindergarten		
Y1	Beginning Consonents	-.0489
Y2	Second Letters	.2559*
Y3	Visual Matching	.1196
Y4	Finding Patterns	.1222
Y5	School Language	-.0757
Y6	Listening	.2770*
Y7	Quantative Concept	.2361*
Y8	Quantative Operations	.3804*
Pre-Kindergarten		
Z1	Draw a Person	.0714
Z2	Circle	-.0087
Z3	Square	.0524
Z4	Triangle	.1789
Z5	Maturity	.0531
Z6	Writing	.0924
Z7	Large Muscles	-.0006
Z234		.1245

*Significance at the .05 level

**Significance at the .01 level